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Data Format Control Document for the Earth Observing System (EOS) Flight Operations Segment (FOS) Project Data Base

Volume 2: AM-1 Mission

Revision A

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Greenbelt, Maryland

DATA FORMAT CONTROL DOCUMENT
for the
Earth Observing System (EOS) Flight Operations Segment (FOS)
Project Data Base
Volume 2: AM-1 Mission

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Preface

This document is a formal contract deliverable with an approval code 1. It requires Government review and approval prior to acceptance and use. This document is under ECS contractor configuration control. Once this document is approved, Contractor approved changes are handled in accordance with Class I and Class II change control requirements described in the EOS Configuration Management Plan, and changes to this document shall be made by document change notice (DCN) or by complete revision.

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Abstract

This Data Format Control Document (DFCD) serves as the Interface Control Document (ICD) defining and controlling the format of the Earth Observing System (EOS) AM-1 Project Data Base (PDB) files and records within those files for the Flight Operations Segment (FOS). The PDB files are used by the FOS in support of mission planning, spacecraft and instrument commanding, and telemetry processing. This document identifies the physical structure of these files, and the format and content of each record.

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Baseline	08/23/96	All	CCR 505-10-35-001-A
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Abbreviations and Acronyms

1. Introduction

1.1 Identification

The Data Format Control Document for the Earth Observing System (EOS) Flight Operations Segment Project Data Base (PDB), Contract Data Requirement List (CDRL) item 029, whose requirements are specified in the Data Item Description (DID) 209/SE1, is a required deliverable under the Earth Observing System Data and Information System (EOSDIS) Core System (ECS), Contract (NAS5-60000).

1.2 Scope

This volume of the Data Format Control Document (DFCD) is an Interface Control Document (ICD) defining and controlling the format of the EOS AM-1 project data base (PDB) files and records within those files for the FOS. These files are used by the EOS Operations Center (EOC) in support of mission planning, spacecraft commanding and telemetry processing for the AM-1 spacecraft. The physical structure of the files, the format and content of each record and examples of record usage are presented.

1.3 Purpose and Objectives

This volume of the DFCD defines the telemetry and command definitions provided by the spacecraft contractor. The information provided in this document will govern these definition files processed at the EOC.

1.4 Status and Schedule

This volume of the DFCD for the EOS FOS PDB is an update to reflect the AM-1 mission criteria.

The final version of the DFCD for the EOS AM-1 PDB was delivered two weeks prior to the ECS Critical Design Review (CDR). It was submitted as a Configuration Control Board (CCB) approval Code 1 document. At the Government's option, the final DFCD may be designated to be under full Government CCB control. After approval, changes may be submitted for consideration by Contractor and Government CCBs under the normal change process at any time.

1.5 Document Organization

This document is organized into an introduction, followed by five sections and an appendix. The introduction provides the document identification, scope, purpose and objectives and the status and schedule. Section 2 provides a bibliography of reference documents for the DFCD. These documents are organized by parent, applicable, and information subsections. Section 3 presents an overview on the PDB files. Section 4 identifies the file content of the PDB and provides a brief description of each file. Section 5 defines the content of each PDB record type. Specific information is identified to govern the accuracy of their content. An abbreviations and acronym list is also provided.

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2. Related Documentation

2.1 Parent Documents

The following documents are the parents from which this document's scope and content derive:

304-CD-001-003	Flight Operations Segment (FOS) Requirements Specification for the ECS Project, Volume 1: General Requirements
304-CD-004-003	Flight Operations Segment (FOS) Requirements Specification for the ECS Project, Volume 2: AM-1 Mission Specific
423-41-01	Goddard Space Flight Center, EOSDIS Core System Statement of Work, June 2, 1994
423-41-02	Goddard Space Flight Center, Functional and Performance Requirements Specification for the Earth Observing System Data and Information System (EOSDIS) Core System, June 2, 1994
505-41-15	Goddard Space Flight Center, Interface Requirements Document Between ECS and EOS-AM Project for AM-1 Flight Operations
none	Interproject Agreement Between AM and ESDIS Projects on Flight Operations for the AM-1 Spacecraft (under development)

2.2 Applicable Documents

The following documents are referenced herein and are directly applicable to this document. In the event of conflict between any of these documents and this document, this document shall take precedence.

305-CD-040-001	Overview of the Flight Operations Segment (FOS) Design Specification for the ECS Project
305-CD-041-001	FOS Planning and Scheduling Design Specification for the ECS Project
305-CD-042-001	FOS Command Management Design Specification for the ECS Project
305-CD-043-001	FOS Resource Management Design Specification for the ECS Project
305-CD-044-001	FOS Telemetry Design Specification for the ECS Project

305-CD-045-001	FOS Command Design Specification for the ECS Project
305-CD-046-001	Real-Time Contact Management Design Specification for the ECS Project
305-CD-047-001	Analysis Design Specification for the ECS Project
305-CD-048-001	FOS User Interface Design Specification for the ECS Project
305-CD-049-001	FOS Data Management Design Specification for the ECS Project
305-CD-050-001	FOS Planning and Scheduling Program Design Language for the ECS Project
305-CD-051-001	FOS Command Management Program Design Language for the ECS Project
305-CD-052-001	FOS Resource Management Program Design Language for the ECS Project
305-CD-053-001	FOS Telemetry Program Design Language for the ECS Project
305-CD-054-001	FOS Real-Time Contact Management Program Design Language for the ECS Project
305-CD-055-001	FOS Analysis Program Design Language for the ECS Project
305-CD-056-001	FOS User Interface Program Design Language for the ECS Project
305-CD-057-001	FOS Data Management Program Design Language for the ECS Project
305-CD-058-001	FOS Command Program Design Language for the ECS Project
none	Lockheed Martin Corporation, EOS-AM Ground System Requirements
none	Lockheed Martin Corporation, AM-1 Spacecraft Analysis Software Requirements Document
ICD-106	Lockheed Martin Corporation, Interface Control Document Data Format Control Book for EOS-AM Spacecraft (ICD-106)

3. PDB Overview

3.1 PDB General Constraints

The following constraints and limitations apply to the PDB for the EOS AM-1 spacecraft:

- The number of PDB files provided by the spacecraft contractor is 15, which are derived from the I&T database.
- Each telemetry parameter may specify up to 4 red/yellow limit sets.
- Each telemetry parameter may specify one delta limit.
- Each telemetry parameter may specify up to 4 calibration curves of one calibration type.
- Each polynomial conversion equation may specify up to 6 coefficients (e.g., 5th order polynomial). At a minimum, each equation must have 2 coefficients.
- Each discrete parameter may specify up to 32 discrete ranges.

3.2 PDB Sizing Assumptions

The following assumptions are being made for the data base sizing estimates for the EOS AM-1 spacecraft:

- The maximum number of telemetry definitions will not exceed 8000.
- The maximum number of command definitions will not exceed 4000.
- The maximum number of activity definitions will not exceed 5000.
- The maximum number of constraint definitions will not exceed 2500.

3.3 PDB Transfer Method

The Project Data Base (PDB) consists of definition files from the Lockheed Martin Corporation's (LMC) Integration and Test (I&T) database and information provided from the FOT. Initially, LMC will provide the telemetry and command definitions for the spacecraft and instrument subsystems. This information is derived from the I&T database. The FOT and IOTs, using database edit tools provided by the FOS, will provide activity and constraint definitions and any additional information needed to support telemetry and command processing.

The method of transfer of the definition files from LMC will be KFTP. Each new release of information from the I&T will be sent to a dedicated directory at the EOC. Additionally, the DBA will be notified of the transfer.

PDB files including command-level constraint definitions will be defined at the EOC by the FOT. Activity-level Constraint definitions will be generated using the Constraint Definer Tool (CDT) and activity definitions will be generated using the Activity Definer Tool (ADT).

The Instrument Operations Team (IOT) will be provided with the capability to update the PDB for their instrument-specific definitions using a database edit tool. This function will be provided as part of the Instrument Support Toolkit (IST) and provides the IOT a mechanism for performing updates to their definitions once the interface to the I&T database ceases to exist.

3.4 PDB Generation Scenario

The PDB generation process is performed in a non-real-time, interactive environment. This process is made up of the following steps:

- The PDB generation process begins with the transfer of PDB files derived from the latest version of the I&T database. The PDB files, containing the telemetry and command definitions, will be sent to a dedicated area at the EOC. These definition files will be loaded into the telemetry and command PDB database tables within the FOS. Each new release of the PDB files from I&T will replace the existing release.
- Activity-level constraint definitions are provided by the FOT and IOTs through the use of the Constraint Definer Tool.
- Activity definitions are provided by the FOT and IOTs through the use of the Activity Definer Tool. Activity definitions will be appended to the activity PDB as needed.
- A database edit function will allow adding, deleting and modification of the contents of the definitions files once loaded into the PDB structures at the EOC. Information not provided by LMC through their I&T database but required for EOC operations can be added by the FOT using this function. Additionally, definition files can be updated; and invalid data can be deleted.
- The IOT can provide changes to the PDB through the use of a database edit tool. Once updates have been made, the IOT must notify the DBA through E-mail. The DBA will be responsible for loading these changes into the PDB after being approved.
- Once corrections and changes have been made to the data definitions, the DBA may invoke validation of the PDB. Validation includes syntax checking, verification of values and cross-checking of related definition files. This step will ensure the accuracy of the definitions used for operations. The generation of a validation report will provide the DBA with the results of the validation. The process of editing and validating the PDB may be repeated until the validated PDB is acceptable for operational use.
- Three methods for validation of the PDB will exist at the EOC. The first method provides for validation of the entire PDB, i.e., validation of the telemetry, command, constraint and activity definitions. This process reflects a specific order which is required to support the integrity of the definitions. The second method provides for validation of the constraint and activity definitions. The third method provides for validation of the activity definitions.

Updates to the constraint and activity PDB may occur independent of a new release of the I&T database. For this reason, the PDB generation process provides validation of the constraint and activity PDB, independent of the other definition files.

- Upon acceptance of the validated PDB, the DBA may invoke the operational data generation process. This step will prepare the definitions for operational use. Operational data generation may occur for the entire validated PDB as in the validation process, for the validated constraint and activity PDB, or for only the validated activity PDB. During this process definitions requiring conversion will be reformatted to support the users need. A version number will be generated reflecting the validated PDB being used, i.e., version 2.1.2 would indicate the second release of the I&T database, with the first version of validated constraints associated with that release and the second version of validated activities associated with that release.

- As part of the operational data generation process, the new version of PDB definitions used for operations will be dumped from the database and distributed. The distribution list for the operational PDB definitions includes the Program Maintenance Library (PML).

- Authorized users of the data base may select to view information maintained in the operational PDB via the IST. The user may access information by PDB file type or by a unique value such as mnemonic. This information may be viewed on a display or can be provided in hard copy form as files.

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4. PDB File Specifications

4.1 PDB File Structure

The Project Data Base (PDB) consists of definitions from the I&T database, the FOT and the IOT. Table 4-1 contains a list of the required filenames for each PDB file from the spacecraft contractor. Each delivery of the PDB from the AM-1 Project to the FOT must include these files. These definitions may be provided through the use of database edit tools or through a file.

The data within the PDB files must be in American Standard Code for Information Interchange (ASCII) text format. Each PDB file must conform to their associated record format described in Section 5.

4.2 PDB File Descriptions

This section provides an overview of the telemetry and command definitions provided by the AM1 project. The FOS operational data generation process will use the PDB, once validated, as input.

4.2.1 Telemetry Files

4.2.1.1 Telemetry Packet Specification PDB

The Telemetry Packet Specification PDB identifies the CCSDS packets used to transmit telemetry parameters for the EOS AM-1 spacecraft. Section 5.1.1 provides the record format.

4.2.1.2 Telemetry Parameter Specification PDB

The Telemetry Parameter Specification PDB defines both analog and discrete telemetry parameters used by the EOS AM-1 spacecraft. This file provides the location of each telemetry parameter and is used to build the telemetry decommutation mapping tables. Section 5.1.2 provides the record format.

4.2.1.3 Telemetry Description PDB

The Telemetry Description PDB provides descriptive information about each telemetry parameter. Section 5.1.3 provides the record format.

4.2.1.4 Telemetry EU Conversion Specification PDB

The Telemetry EU Conversion Specification PDB provides a list of telemetry parameters with EU conversion information defined. Section 5.1.4 provides the record format.

Table 4-1. List of PDB Files

Filename	PDB Source	Description
tlm_packet_xxx.pdb	FOT	Telemetry Packet Specification PDB
tlm_parm_xxx.pdb	I&T	Telemetry Parameter Specification PDB
tlm_desc_xxx.pdb	I&T	Telemetry Description PDB
tlm_calcurve_xxx.pdb	I&T, FOT	Telemetry EU Conversion Specification PDB
tlm_polyconv_xxx.pdb	I&T	Polynomial Coefficients Specification PDB
tlm_rylim_xxx.pdb	I&T, FOT	Red/Yellow Limit Specification PDB
tlm_limsel_xxx.pdb	I&T, FOT	Limit Selection Specification PDB
tlm_delta_xxx.pdb	I&T	Delta Limit Specification PDB
tlm_dstate_xxx.pdb	I&T	Discrete State Specification PDB
tlm_lgdesc_xxx.pdb	I&T	Telemetry Long Description PDB
cmd_parm_xxx.pdb	I&T	Command Parameter Specification PDB
cmd_desc_xxx.pdb	I&T	Command Description PDB
cmd_fixdata_xxx.pdb	I&T	Command Fixed Data Word Specification PDB
cmd_vardata_xxx.pdb	I&T	Command Variable Data Word Specification PDB
cmd_verify_xxx.pdb	I&T	Command Execution Verification (CEV) PDB
cmd_lgdesc_xxx.pdb	I&T	Command Long Description PDB

Note: xxx represent the version number (000-999) associated with the PDB.

4.2.1.5 Polynomial Coefficients Specification PDB

The Polynomial Coefficients Specification PDB defines the engineering unit (EU) conversion criteria using a polynomial equation for the specified telemetry parameters. Section 5.1.5 provides the record format.

4.2.1.6 Red/Yellow Limit Specification PDB

The Red/Yellow Limit Specification PDB defines telemetry parameters that are limit checked using a red/yellow - high/low criteria. Each telemetry parameter may specify up to 4 different limit sets. Section 5.1.6 provides the record format.

4.2.1.7 Limit Selection Specification PDB

The Limit Set Specification PDB defines the criteria for selection of a limit set for those telemetry parameters having limits sets defined. Section 5.1.7 provides the record format.

4.2.1.8 Delta Limit Specification PDB

The Delta Limit Specification PDB defines telemetry parameters that are limit checked using a delta limit criterion. Delta limit checking refers to checking a parameter based on the change in value of successive samples. Each telemetry parameter may specify one delta limit. Section 5.1.8 provides the record format.

4.2.1.9 Discrete State Specification PDB

The Discrete State Specification PDB associates ASCII text with a range of values for discrete telemetry parameters. Each discrete parameter may specify up to 32 ranges. Section 5.1.9 provides the record format.

4.2.1.10 Telemetry Long Description PDB

The Telemetry Long Description PDB provides the detailed description of a telemetry parameter. Section 5.1.13 provides the record format.

4.2.2 Command Files

4.2.2.1 Command Parameter Specification PDB

The Command Parameter Specification PDB defines parameters used in support of spacecraft and instrument commanding for the EOS AM-1 spacecraft. This file contains information necessary to construct commands. Additionally, this file provides characteristics of the command such as safety level. Section 5.2.1 provides the record format.

4.2.2.2 Command Description PDB

The Command Description Specification PDB provides descriptive information about each spacecraft and instrument command. Section 5.2.2 provides the record format.

4.2.2.3 Command Fixed Data Word Specification PDB

The Command Fixed Data Word Specification PDB defines the fixed data words associated with a command. Each command may specify up to 33 16-bit words including the command destination and command descriptor. Section 5.2.3 provides the record format.

4.2.2.4 Command Variable Data Word Specification PDB

The Command Variable Data Word Specification PDB defines commands that require parameter input by the user. These commands may contain both fixed and variable data words. Each command of variable type may reference up to 10 subfield names. Each subfield may define up to 10 states. Section 5.2.4 provides the record format.

4.2.2.5 Command Execution Verification (CEV) PDB

The Command Execution Verification PDB defines telemetry parameters that support verification of command execution and reception. Each command may specify one discrete telemetry parameter as a verifier. Section 5.2.5 provides the record format.

4.2.2.6 Command Long Description PDB

The Command Long Description PDB provides the detailed description of a command parameter. Section 5.2.7 provides the record format.

4.3 PDB Record Structure

The following rules apply to all records in each PDB file:

- The format for each record must be in ASCII text.
- All records in a file must be in the same format and must be of a fixed length, as specified in Section 5, unless otherwise noted.
- Each record in a file must terminate with an ASCII new-line character.
- Fields in a record must be separated by the vertical bar "|" delimiter. (Delimiters are not enumerated in the record format.)

4.4 PDB Field Structure

The following rules apply to all PDB record fields:

- ASCII field may contain alphabetic, numeric and special characters.
- Field that contain values specified as integer are assumed to be decimal integer unless otherwise noted in the field description.
- The length of each field is specified in Section 5. If data in a field is shorter than the specified length, it must be padded with blanks. If an optional field has no data, it must be filled with blanks.
- To improve readability, all alphanumeric and other non numeric data should be left justified, and all numeric data should be right justified.
- Descriptor fields and those that are specified in their description are the only optional fields. All other fields are required fields and must contain data other than all blanks.
- The bits are ordered from left to right according to the Consultative Committee for Space Data Systems (CCSDS) Advanced Orbiting Systems (AOS) bit/byte numbering convention. Bit 0 is the most significant bit (MSB), bit 7 is the least significant bit (LSB).

5. PDB Record Format Specifications

This section provides the format of each PDB record. Each record definition contains the record format, the record length, and a brief description of the fields in each record. The record length includes the new-line character, which marks the end of the record, and the vertical bar delimiter "|", which separates the fields within each record. The description of each field provides the validation criteria performed on the PDB record.

5.1 Telemetry Records

5.1.1 Telemetry Packet Specification Record

The Telemetry Packet Specification Record defines valid CCSDS packets for processing by the FOS. The telemetry processing functions will use this information to extract the CCSDS standard source data packets from the telemetry EOS Data Operations System (EDOS) Data Units (EDUs). The packet types supported by the EOS AM-1 spacecraft include housekeeping packets, health & safety packets, diagnostic packets and standby CTIU packets.

PDB Source: FOT

Record Length: 91

Record Format:

Field	Start Byte	End Byte	Total Bytes	Contents
1	1	4	4	Application process identifier (APID)
2	6	9	4	Packet length
3	11	90	80	Packet descriptor

Detailed Field Descriptions:

1. The application process identifier is specified with a four character decimal integer (0-2047) uniquely identifying the type of packet from the S-bank downlink to be decommutated by the FOS for EOS AM-1, where:

   1 = Housekeeping telemetry

   2 = Health & safety telemetry

   3 = Diagnostic telemetry - 16 kbps

   5 = Standby CTIU

   6 = Diagnostic telemetry - 1 kbps

2. The packet length is specified as a four character decimal integer (1-1664) defining the expected length in bytes of the telemetry packet including the primary header, secondary

header and application data field. Valid packet lengths for the telemetry supported by EOS AM-1 include:

1664 = Housekeeping and Diagnostic-16 kbps Telemetry

208 = Health & Safety, Diagnostic and Standby-1 kbps Telemetry

3. The packet descriptor is specified with 80 ASCII characters providing textual information describing the telemetry packet.

5.1.2 Telemetry Parameter Specification Record

The Telemetry Parameter Specification Record identifies analog and discrete telemetry parameters supporting the EOS AM-1 spacecraft. Each record contains location information used to decommutate the downlink telemetry streams. A telemetry parameter is uniquely identified by the application process identifier, telemetry identifier, telemetry mnemonic, major cycle ID and the telemetry instance.

PDB Source: I&T

Record Length: 60

Record Format:

Field	Start Byte	End Byte	Total Bytes	Contents
1	1	4	4	Application process identifier (APID)
2	6	10	5	Telemetry parameter identifier
3	12	31	20	Telemetry mnemonic
4	33	34	2	Major cycle ID
5	36	38	3	Telemetry instance
6	40	44	5	Packet offset
7	46	47	2	Size in bits
8	49	54	6	Delta time
9	56	59	4	Parameter data representation

Detailed Field Descriptions

1. The application process identifier is specified with a four character decimal integer (0-2047) identifying the type of packet from the S-bank downlink to be decommutated by the FOS for EOS AM-1, where:

   1 = Housekeeping telemetry

   2 = Health & safety telemetry

   3 = Diagnostic-16 kbps telemetry

   5 = Standby CTIU

   6 = Diagnostic-1 kbps telemetry

   This value must also be defined in the Telemetry Packet Specification PDB.

2. The telemetry parameter identifier is specified as a five character decimal integer and uniquely represents the telemetry parameter. This value must also be defined in the Telemetry Description PDB.

3. The telemetry mnemonic identifies each parameter supporting telemetry processing for the EOS AM-1 spacecraft. The telemetry mnemonic is a unique name consisting of 7-20 characters representing a telemetry point. Each telemetry mnemonic will be defined in the following format:

   AAA_BC_D...D

   where:

   AAA represents the spacecraft subsystem or instruments, where:

   AST = Advanced Spaceborne Thermal Emission and Reflection Radiometer

   CEA = Clouds and the Earth's Radiant Energy Subsystem -Aft

   CEF = Clouds and the Earth's Radiant Energy Subsystem -Fore

   CDH = Command & Data Handling Subsystem

   COM = Communications Subsystem

   EAS = Electrical Accommodation Subsystem

   EPS = Power Subsystem

   FS1 = Flight Software Subsystem - SCC1

   FS2 = Flight Software Subsystem - SCC2

   GNC = Guidance, Navigation and Control Subsystem

   MIS = Multi-angle Imaging Spectro - Radiometer

   MOD = Moderate Resolution Imaging Spectrometer

   MOP = Measurement of Pollution in the Troposphere

   PMS = Propulsion Module Subsystem

   SMS = Structures and Mechanism Subsystem

   TCS = Thermal Control Subsystem

   B represents the telemetry sample type, where:

   I = current

   V = voltage

   T = temperature

   B = bi-level status

P = power

C = configuration information

S = status information

N = numeric counter

C represents the telemetry point source type, where:

R = real or raw data

S = flight software generated data

D = pseudo or derived data

P = passive analog

A = active analog

D represents 1 to 13 uppercase characters describing the telemetry point function.

4. The major cycle ID is specified as a two character decimal integer and uniquely identifies the major cycle number within a master cycle for the individual packet. The valid upper bound for this value is dependent on the type of telemetry packet, where:

   0-63 = Housekeeping and Diagnostic-16 kbps Telemetry

   0-31 = Health & Safety and Diagnostic-1 kbps Telemetry

   A complete sequence of ID values must be defined for each master cycle (e.g., all major cycle IDs, 0 through 63, must be defined for housekeeping telemetry).

5. The telemetry instance is specified as a three character decimal integer and identifies the occurrence of the telemetry parameter within the packet. This value is used to indicate those telemetry points that occur more than once in the downlink packet (supercommutated). This value does not indicate the order in which the telemetry point occurs.

6. The packet offset is specified as a five character decimal integer (1-13312) and represents the bit offset within the packet where the most significant bit of a telemetry value is located. This value reflects the offset from the start of the application data.

7. The size in bits is specified as a two character decimal integer (1-48) and indicates the number of bits in the data stream used to define the telemetry value.

8. The delta time is specified as a six character decimal integer (0-+/-65536) representing the time, in milliseconds, that must be added/subtracted to the spacecraft packet time stamp for each telemetry point to ensure accuracy of spacecraft events.

9. The parameter data representation is specified with four ASCII characters and represents the data type. Valid data types for AM-1 include:

   UI = unsigned word integer (1-32 bits)

   SI = two's complement signed word integer (1-32 bits)

   Fl = single precision floating point in MIL-STD-1750A format (32/48 bits)

5.1.3 Telemetry Description Record

The Telemetry Description Record provides descriptive information about a telemetry parameter.

PDB Source: I&T

Record Length: 215

Record Format:

Field	Start Byte	End Byte	Total Bytes	Contents
1	1	5	5	Telemetry parameter identifier
2	7	26	20	Telemetry mnemonic
3	28	44	17	Major assembly name
4	46	75	30	Component name
5	77	106	30	Subassembly name
6	108	126	19	Remote terminal ID name
7	128	149	22	Telemetry type
8	151	151	1	Parameter type
9	153	153	1	SCC requirement flag
10	155	214	60	Telemetry description

Detailed Field Descriptions:

1. The telemetry parameter identifier is specified as a five character decimal integer and uniquely represents the telemetry parameter. This value must also be defined in the Telemetry Parameter Specification PDB.

2. The telemetry mnemonic is specified with 20 ASCII characters representing the name of the telemetry parameter. The format for this name is specified in Section 5.1.2.

3. The major assembly name is specified with 17 ASCII characters and identifies the source of the telemetry point.

4. The component name is specified with 30 ASCII characters and identifies the name of the end spacecraft component that is the source of the telemetry point.

5. The subassembly name is specified with 30 ASCII characters and identifies the name of the subassembly within the component that contains the telemetry circuit.

6. The remote terminal ID name is specified with 19 ASCII characters and indicates the name of the remote terminal on the C&T Bus that will transfer the sample telemetry to the CTIU.

7. The telemetry type is specified with 22 ASCII characters and identifies the classification of the telemetry point with respect to the spacecraft remote terminal and end component interface. Valid telemetry types include:

   BDU Active Analog

   BDU Active Bi-Level

BDU Passive Bi-Level
BDU Serial TLM
BDU Serial TLM Sync
BDU Serial TLM Enbl
BDU Serial Clk
BDU NO-OP
Derived
ERT Active Analog
ERT Passive Analog
ERT Active Bi-Level
ERT Passive Bi-Level
ERT Serial
ERT SW

8. The parameter type is specified with one ASCII character identifying the type of parameter, where:

   A = ANALOG

   D = DISCRETE

9. The SSC requirement flag is specified with one ASCII character indicating the telemetry points that use the spacecraft controls computer for processing, where:

   N = not required by the SCC

   R = required by the SCC

10. The telemetry description is specified with 60 ASCII characters and provides textual information describing a telemetry point.

5.1.4 Telemetry EU Conversion Specification Record

The Telemetry EU Conversion Specification Record provides the necessary information for the conversion of a raw analog telemetry data number (DN) to an engineering unit (EU) such as amps or volts. The calibration scaling factor is used to allow very large or small numbers to be defined by a telemetry point. The scaling factor will be applied to each equation using the following format: EU = (1/2**scale factor) * (Calibration Equation) during the process of preparing the definitions for operational use. Additionally, information for conversion selection may be specified with a switch mnemonic and its min/max values. Each analog parameter may specify up to four different EU conversion equations. The segment number refer to the number of the segment. This value is set to 1 for unsegmented conversion types.

PDB Source: I&T, FOT

Record Length: 99

Record Format:

Field	Start Byte	End Byte	Total Bytes	Contents
1	1	5	5	Telemetry parameter identifier
2	7	26	20	Telemetry mnemonic
3	28	32	5	Conversion type
4	34	37	4	Conversion group number
5	39	42	4	Calibration scaling factor
6	44	46	3	Data units
7	48	67	20	Conversion switch mnemonic
8	69	81	13	Minimum value
9	83	95	13	Maximum value
10	97	98	2	Segment number

Detailed Field Descriptions:

1. The telemetry parameter identifier is specified as a five character decimal integer and uniquely represents the telemetry parameter. This value must also be defined in the Telemetry Description PDB and of the parameter type analog.

2. The telemetry mnemonic is specified with 20 ASCII characters representing the name of the telemetry parameter. The format for this name is specified in Section 5.1.2. This name must also be defined in the Telemetry Description PDB in combination with its telemetry parameter id.

3. The conversion type is specified with five ASCII characters indicating the type of calibration conversion to be performed on the telemetry point. Valid values include:

   U_5D = unsegmented_5D EU = C0 + C1X + C2X**2 + C3X**3 + C4X**4 + C5X**5

   U_EXP = unsegmented_EXP EU = C0 + C1e**(C2X)

   S_3D = segmented_3D EU = C0 + C1X + C2X**2 + C3X **3

   e - represents the natural constant (2.71828182846)

4. The conversion group number is specified as a four character decimal integer identifying the set of polynomial coefficients to be used in the conversion equation. This number must also be defined in the Polynomial Coefficients Specification PDB.

5. The calibration scaling factor is specified as a four character decimal integer defining the power of 2 by which the calibration equation is divided by: EU = (1/2**SF)*(Calibration Equation). A default value of zero indicates scaling is not performed on the telemetry point.

6. The data units is specified with three ASCII characters and represents an abbreviation for the engineering units to which a raw telemetry data number is converted to. Valid data units include:

A = amp
AM2 = amp-meter2
ANY = arbitrary
APC = amp/count
AS = arc second
AS2 = arc second/second
ATM = atmosphere
BPM = beat/min
BPS = beat/second
C = degree Celcius
CM = centimeter
CM2 = centimeter2
CM3 = centimeter3
CNT = count
COU = coulomb
CPA = count/amp
DAY = day of month
DB = decibal
DBH = decibal-hertz
DBM = decibal-meter
DBW = decibal-watt
DEG = degree of arc
DEGS = degree/second
DN = data number
DOY = day of year
DPS = degree/second
DS2 = degree second2
F = degree Farenheit
FAR = Faraday

FPM = feet/min

FPS = feet/seconds

FT = feet

FT2 = feet2

G = gravitation

G2 = gauss2

GAL = gallon

GHZ = gigahertz

GM = gram

GPC = gauss/count

HR = hour

HZ = hertz

HZ2 = hertz2

IN2 = inche2

IN3 = inche3

J = joule

JM2 = joule/meter2

K = degree Kelvin

KG = kilogram

KHZ = kilohertz

KM = kilometer

KM2 = kilometer2

KPH = kilometer/hour

KPM = kilometer/min

KPS = kilometer/second

KV = kilovolt

KW = kilowatt

KWH = kilowatt-hour

L = liter

LM = lumen

LX = lux

M = meter

M2 = meter2

MA = milliamp

MB = millibar

MG = milligram

MHZ = megahertz

MI = mile

MIC

MIN = minute

ML = milliliter

MM = millimeter

MON = month

MPH = miles/hour

MPS = mile/second

MS = millisecond

MV = millivolt

N = newton

NM = nanometer

NM2 = newton/meter2

NMI = nautical mile

NMS = newton-meter-sec

NT = newton

OHM = ohm

OZI = ounce-inch

PC = pole centimeter

PHO = photon

PSI = pound/inch2

QT = quart

R2S = radian2/second2

RAD = radian

RDS = radian-second

RPC = radian/count

RPM = revolution/min

RPS = revolution/second

RS2 = radian/second2

SEC = second

SPF = second/frame

T = Torr

T2 = tesin2

UM = micrometer

US = microsecond

V = volt

W = watt

WK = week

YR = year

7. The conversion switch mnemonic is specified with 20 ASCII characters identifying the telemetry parameter whose value determines the equation to use when performing EU conversion. This name must be defined in the Telemetry Description PDB or the Derived Telemetry PDB.

8. The minimum value is specified as a 13-character decimal integer. This value represents the lower limit, inclusively, of the range of values of the conversion switch mnemonic (field 7) for which the parameter will use the associated conversion equation. This value must be less than or equal to the maximum switch value (field 9).

9. The maximum value is specified as a 13-character decimal integer. This value represents the upper limit, inclusively, of the range of values of the conversion switch mnemonic (field 7) for which the parameter will use the associated conversion equation. This value must be greater than or equal to the minimum switch value (field 8).

10. The segment number is specified with a two-character decimal integer. This value represent the number of the segment. This value is set to 1 for unsegmented conversion types.

5.1.5 Polynomial Coefficients Specification Record

The Polynomial Coefficients Specification Record defines the coefficients used to convert raw telemetry values into EUs using a polynomial equation. Each conversion equation is identified by a conversion group number and name. Multiple telemetry parameters may access the same conversion equation by its group number. Equations up to the fifth order may be stored for any one group, with the number of valid coefficients dependent on the type of conversion.

PDB Source: I&T

Record Length: 128

Record Format:

Field	Start Byte	End Byte	Total Bytes	Contents
1	1	5	5	Conversion group number
2	7	31	25	Conversion group name
3	33	47	15	Coefficient #0
4	49	63	15	Coefficient #1
5	65	79	15	Coefficient #2
6	81	95	15	Coefficient #3
7	97	111	15	Coefficient #4
8	113	127	15	Coefficient #5

Detailed Field Descriptions:

1. The conversion group number is specified with a five character decimal integer and uniquely identifies a set of coefficients associated with a conversion equation.
2. The conversion group name is specified with 25 ASCII characters and represents a set of coefficients by name.
3. Coefficient #0 is specified with a 15-character floating-point number representing the value of the constant in the equation.
4. Coefficient #1 is specified with a 15-character floating-point number representing the value of the coefficient for the first order in the equation.
5. Coefficient #2 is specified with a 15-character floating-point number representing the value of the coefficient for the second order in the equation.
6. Coefficient #3 is specified with a 15-character floating-point number representing the value of the coefficient for the third order in the equation.
7. Coefficient #4 is specified with a 15-character floating-point number representing the value of the coefficient for the fourth order in the equation.
8. Coefficient #5 is specified with a 15-character floating-point number representing the value of the coefficient for the fifth order in the equation.

5.1.6 Red/Yellow Limit Specification Record

The Red/Yellow Limit Specification Record defines the red/yellow - high/low limit checking criteria associated with an analog, discrete or derived telemetry parameter. A yellow out-of-limits condition indicates the component is no longer healthy and action should be taken to prevent a hazardous situation. A red out-of-limits condition indicates the component is in imminent danger of suffering damage and immediate action is required. Each parameter may specify up to four limit sets defining these conditions.

PDB Source: I&T, FOT

Record Length: 96

Record Format:

Field	Start Byte	End Byte	Total Bytes	Contents
1	1	5	5	Telemetry parameter identifier
2	7	26	20	Telemetry mnemonic
3	28	28	1	Limit set number
4	30	31	2	DN/EU indicator
5	33	47	15	Red low limit
6	49	63	15	Yellow low limit
7	65	79	15	Yellow high limit
8	81	95	15	Red high limit

Detailed Field Descriptions:

1. The telemetry parameter identifier is specified as a five character decimal integer and uniquely represents the telemetry parameter. This value must also be defined in the Telemetry Description Specification PDB.

2. The telemetry mnemonic is specified with 20 ASCII characters representing the name of the telemetry parameter. The format for this name is specified in Section 5.1.2. This name must also be defined in the Telemetry Description Specification PDB in combination with its telemetry parameter id.

3. The limit set number is specified as a one character decimal integer (1-4) identifying the set of limits associated with the telemetry parameter. Each parameter may define up to 4 limit sets. Set numbers must be used in order beginning with number 1, i.e., limit set 3 cannot be defined unless limit set 2 has been defined.

4. The DN/EU indicator is specified with two ASCII characters indicating the units a limit value is defined as, i.e. raw data number or engineering units, where:

   DN = raw data number

   EU = engineering units

This field is only used for analog telemetry parameters, therefore the telemetry parameter must be of the parameter type analog. Additionally, a parameter with its limit set expressed in engineering units must also specify a conversion type in it's associated Telemetry EU Conversion Specification PDB. All limit sets for a particular parameter must be defined as DN or EU but not a combination of the both.

5. The red low limit is specified with 15-characters defining the low dangerous limit value for the telemetry parameter. The format for this field is determined by the DN/EU indicator (field 4). A DN/EU indicator set to DN indicates this value will be defined as a raw data number and contains a decimal integer. A DN/EU indicator set to EU indicates this value will be defined in engineering units and contains a floating-point number. This value must be less then the yellow low limit (field 6).

6. The yellow low limit is specified with 15-characters defining the low warning limit value for the telemetry parameter. The format for this field is determined by the DN/EU indicator (field 4). A DN/EU indicator set to DN indicates this value will be defined as a raw data number and contains a decimal integer. A DN/EU indicator set to EU indicates this value will be defined in engineering units and contains a floating-point number. This value must be greater than the red low limit (field 5) and less then the yellow high limit (field 7).

7. The yellow high limit is specified with 15-characters defining the high warning limit value for the telemetry parameter. The format for this field is determined by the DN/EU indicator (field 4). A DN/EU indicator set to DN indicates this value will be defined as a raw data number and contains a decimal integer. A DN/EU indicator set to EU indicates this value will be defined in engineering units and contains a floating-point number. This value must be greater then the yellow low limit (field 6) and less then the red high limit (field 8).

8. The red high limit is specified with 15-characters defining the high dangerous limit value for the telemetry parameter. The format for this field is determined by the DN/EU indicator (field 4). A DN/EU indicator set to DN indicates this value will be defined as a raw data number and contains a decimal integer. A DN/EU indicator set to EU indicates this value will be defined in engineering units and contains a floating-point number. This value must be greater then the yellow high limit (field 7).

5.1.7 Limit Selection Specification Record

The Limit Selection Specification Record defines the criteria for selecting a limit set for a telemetry parameter. The value of the parameter defined by the limit switch mnemonic will indicate the limit set to use. Each parameter may define up to four limit sets.

PDB Source: I&T, FOT

Record Length: 78

Record Format:

Field	Start Byte	End Byte	Total Bytes	Contents
1	1	5	5	Telemetry parameter identifier
2	7	26	20	Telemetry mnemonic
3	28	28	1	Limit set number
4	30	49	20	Limit switch mnemonic
5	51	63	13	Minimum switch value
6	65	77	13	Maximum switch value

Detailed Field Descriptions:

1. The telemetry identifier is specified as a five character decimal integer and uniquely represents the telemetry parameter. This value must also be defined in the Red/Yellow Limit Specification PDB.

2. The telemetry mnemonic is specified with 20 ASCII characters representing the name of the telemetry parameter. The format for this name is specified in Section 5.1.2. This name must also be defined in the Red/Yellow Limit Specification PDB in combination with its telemetry parameter id.

3. The limit set number is specified as a one character decimal integer (1-4) identifying the limit set associated with the telemetry parameter (field 1). Each parameter may define up to 4 limit sets. Set numbers must be used in order beginning with number 1, i.e., limit set 3 cannot be defined unless limit set 2 has been defined. This number must also be defined in the Red/Yellow Limit Specification PDB in association with it's telemetry parameter id (field 1).

4. The limit switch mnemonic is specified with 20 ASCII characters identifying a telemetry parameter whose value determines the limit set to use when performing limit checking. The format for this name is specified in Section 5.1.1. This name must be defined in the Telemetry Description PDB.

5. The minimum switch value is specified as a 13-character decimal integer identifying the lower limit, inclusively, of the range of values of the limit switch mnemonic (field 4) for which the parameter will be limit checked. This value must be less than or equal to the maximum switch value (field 6).

6. The maximum switch value is specified as a 13-character decimal integer identifying the upper limit, inclusively, of the range of values of the limit switch mnemonic (field 4) for which the parameter will be limit checked. This value must be greater than or equal to the minimum switch value (field 5).

5.1.8 Delta Limit Specification Record

The Delta Limit Specification Record defines delta limit checking criteria associated with a telemetry parameter. Delta limits refers to the maximum difference between two consecutive samples that is considered normal. Each telemetry parameter may define one delta limit.

PDB Source: I&T

Record Length: 46

Record Format:

Field	Start Byte	End Byte	Total Bytes	Contents
1	1	5	5	Telemetry parameter identifier
2	7	26	20	Telemetry mnemonic
3	28	29	2	DN/EU indicator
4	31	45	15	Delta limit value

Detailed Field Descriptions:

1. The telemetry parameter identifier is specified as a five character decimal integer representing an analog, discrete or derived telemetry parameter. This value must also be defined in the Telemetry Description Specification PDB.

2. The telemetry mnemonic is specified with 20 ASCII characters representing the name of the telemetry parameter. The format for this name is specified in Section 5.1.2. This name must also be defined in the Telemetry Description Specification PDB or the Derived Telemetry Specification PDB in combination with its telemetry parameter id.

3. The DN/EU indicator is specified with two ASCII characters indicating the units a delta limit value is defined as, i.e. raw data number or engineering units, where:

   DN = raw data number

   EU = engineering units

   This field is only used for analog telemetry parameters, therefore the telemetry parameter must be of type analog. Additionally, a parameter with its delta limit expressed in engineering units must specify a conversion type in it's associated Telemetry EU Conversion Specification PDB.

4. The delta limit value is specified with 15 characters defining the maximum absolute successive change allowed for this telemetry parameter. The format for this field is determined by the DN/EU indicator (field 3). A DN/EU indicator set to DN indicates this value will be defined as a raw data number and contains a decimal integer. A DN/EU indicator set to EU indicates this value will be defined in engineering units and contains a floating point number.

5.1.9 Discrete States Specification Record

The Discrete States Specification Record associates a single text state to a range of values for a discrete telemetry parameter. This text is the discrete state of the parameter and is used by FOS User Interface Subsystem. Each discrete telemetry parameter may have up to 32 different ranges specified.

PDB Source: I&T

Record Length: 66

Record Format:

Field	Start Byte	End Byte	Total Bytes	Contents
1	1	5	5	Telemetry parameter identifier
2	7	26	20	Telemetry mnemonic
3	28	40	10	Minimum range value
4	39	48	10	Maximum range value
5	50	65	16	Discrete state text

Detailed Field Descriptions:

1. The telemetry parameter identifier is specified as a five character decimal integer representing a discrete telemetry parameter. This value must also be defined in the Telemetry Description PDB and of the parameter type discrete.

2. The telemetry mnemonic is specified with 20 ASCII characters representing the name of the telemetry parameter. The format for this name is specified in Section 5.1.2. This name must also be defined in the Telemetry Descriptor PDB in combination with its telemetry parameter id.

3. The minimum range value is specified as a 10-character decimal integer representing the low-order end of the discrete range. The minimum range value must be less than or equal to the maximum range value (field 4).

4. The maximum range value is specified as a 10-character decimal integer representing the high-order end of the discrete range. The maximum range value must be greater than or equal to the maximum range value (field 3).

5. The discrete state text is specified with 16 ASCII characters and provides the text associated with the discrete range (fields 3 and 4).

5.1.10 Telemetry Long Description Record

The Telemetry Long Description Record provides a detailed description for a telemetry parameter.

PDB Source: I&T

Record Length: 1628

Record Format:

Field	Start Byte	End Byte	Total Bytes	Contents
1	1	5	5	Telemetry parameter identifier
2	7	26	20	Telemetry mnemonic
3	28	1627	1600	Telemetry long description

Detailed Field Descriptions:

1. The telemetry parameter identifier is specified as a five character decimal integer and uniquely represents the telemetry parameter. This value must also be defined in the Telemetry Description PDB.

2. The telemetry mnemonic is specified with 20 ASCII characters representing the name of the telemetry parameter. The format for this name is specified in Section 5.1.2. This name must also be defined in the Telemetry Description PDB in combination with its telemetry parameter id.

3. The telemetry long description is specified with 1600 ASCII characters providing a detailed description of the telemetry parameter.

5.2 Command Records

5.2.1 Command Parameter Specification Record

The Command Parameter Specification Record defines a spacecraft or instrument command which is used to support the EOS AM-1 spacecraft. Each record provides the construction information for a command.

PDB Source: I&T

Record Length: 88

Record Format:

Field	Start Byte	End Byte	Total Bytes	Contents
1	1	5	5	Command parameter identifier
2	7	26	20	Command mnemonic
3	28	42	15	Command type
4	44	62	19	Remote terminal ID name
5	64	80	17	Remote terminal subaddress name
6	82	83	2	Command word count
7	85	85	1	Command data word type
8	87	87	1	Safety level

Detailed Field Descriptions:

1. The command parameter identifier is specified with a five character decimal integer uniquely identifying the spacecraft or instrument command parameter.

2. The command mnemonic identifies the each spacecraft or instrument command parameter. The command mnemonic is a unique name consisting of 14-20 characters representing a spacecraft or instrument command for the EOS AM-1 spacecraft; the format is specified as follows:

   AAA_<Command Verb>_<Command Name>

   where:

   AAA is three uppercase characters representing spacecraft subsystem or instruments;

   where

   AST = Advanced Spaceborne Thermal Emission and Reflection Radiometer

   CEA = Clouds and the Earth's Radiant Energy Subsystem -Aft

   CEF = Clouds and the Earth's Radiant Energy Subsystem -Fore

   CDH = Command & Data Handling Subsystem

   COM = Communications Subsystem

   EAS = Electrical Accommodation Subsystem

   EPS = Power Subsystem

   FS1 = Flight Software Subsystem - SCC1

   FS2 = Flight Software Subsystem - SCC2

   GNC = Guidance, Navigation and Control Subsystem

   MIS = Multi-angle Imaging Spectro - Radiometer

   MOD = Moderate Resolution Imaging Spectrometer

   MOP = Measurement of Pollution in the Troposphere

   PMS = Propulsion Module Subsystem

   SMS = Structures and Mechanism Subsystem

   TCS = Thermal Control Subsystem

   <Command Verb> is specified with 3 to 9 uppercase characters representing the command verb; valid values for the EOS AM-1 spacecraft include:

ACTIVATE

ARM

BOOT

CHANGE

CLOSE

DISABLE

DISARM

DRIVE

DUMP

ENABLE

FIRE

FLYBACK

FORCEOFF

FORCEON

GET

HALT

IGNORE

INITIATE

LOAD

MLOAD

MOVE

OPEN

PASS

PERFORM

RESET

SELECT

SET

SLEW

STEP

TOGGLE

TURN_OFF

TURN_ON

USE

<Command Name> specifies 6 to 12 uppercase characters representing the command name describing the function to be performed on-board the spacecraft. The actual length of the command name is dependent on the command verb.

3. The command type is specified with 15 ASCII characters identifying the command classification with respect to the RT and end component interface; valid values include:

   BDU NO-OP

   BDU Serial CMD

   BDU Serial CMD Enbl

   BDU - Relay Pulse

   BDU - Logic Pulse

   CTIU BC

   ERT - Serial

   ERT Relay Pulse

   ERT Logic Pulse

   ERT Load Init

   ERT Load Init Tbl

   ERT Load Term

   ERT Load Data

   ERT Load File

   ERT Dump Init

   ERT Dump Term

   ERT Dump Manage

4. The remote terminal (RT) ID name is specified with 19 ASCII characters identifying the name of the remote terminal to which a command is sent to over the 1553 Command and Telemetry (C&T) bus; valid spacecraft RT ID's include:

   Active CTIU

ASTER

ASTER BDU

C&DH/COMM BDU

CERES-A

CERES-F

CTIU1

CTIU2

DAS BDU

GN&C BDU

HGA-1

HGA-2

MISR

MIS/MOP/CER BDU

MODIS

MODIS BDU

MOPITT

N/A

Power BDU

PROP BDU

Recorder BDU

RWA BDU

SCC1

SCC2

SSST1

SSST2

Standby CTIU

5. The RT subaddress name is specified with 17 ASCII characters representing the name of the remote terminal subaddress the command is sent to.

6. The command word count is specified as a two character decimal integer (1-32) indicating the number of 16-bit words which follow the command destination (1553 message header)

in the command structure. The command descriptor and optional command data words are included in this count. A value greater than 1 would indicate command data words exist.

7. The command data word type is specified with one ASCII character representing the source of the command data, where:

   F = FIXED; assembled from a fixed bit pattern

   V = VARIABLE; user specified

   Note: A FIXED command data word type would indicate the presence of fixed type command data words associated with the command. A VARIABLE command data word type may also contain a fix part of the bit pattern and therefore would have both fixed and variable type command data words.

8. The safety level is specified with one ASCII character indicating whether the command is critical to the spacecraft hardware and/or personnel. Valid values include:

   H = HAZARDOUS

   S = SAFE

5.2.2 Command Description Record

The Command Description Record provides descriptive information about a spacecraft or instrument command parameter.

PDB Source: I&T

Record Length: 188

Record Format:

Field	Start Byte	End Byte	Total Bytes	Contents
1	1	5	5	Command parameter identifier
2	7	26	20	Command mnemonic
3	28	44	17	Major assembly
4	46	75	30	Component name
5	77	106	30	Subassembly name
6	108	187	80	Command description

Detailed Field Descriptions:

1. The command identifier is specified as a five character decimal integer and uniquely represents the command parameter. This value must also be specified in the Command Parameter Specification PDB.

2. The command mnemonic is specified with 20 ASCII characters representing the name of the command parameter. The format for this name is defined in Section 5.2.1. This value must also be specified in the Command Parameter Specification PDB in combination with the command parameter id.

3. The major assembly is specified with 17 ASCII characters and identifies the name of the spacecraft major assembly which contains the component that will receive the command.

4. The component name is specified with 30 ASCII characters and is used to identify the spacecraft component that receives the command.

5. The subassembly name is specified with 30 ASCII characters and is used to identify the name of the subassembly within the component that will be affected by the command. This value is not required by all commands.

6. The command short description is specified with 80 ASCII characters and provides textual information describing the spacecraft or instrument command.

5.2.3 Command Fixed Data Word Specification Record

The Command Fixed Data Word Specification Record defines the data words (1-N) associated with the fixed bit pattern of a command. Word 1 would represent the command destination and word 2 represents the command descriptor.

PDB Source: I&T

Record Length: 35

Record Format:

Field	Start Byte	End Byte	Total Bytes	Contents
1	1	5	5	Command parameter identifier
2	7	26	20	Command mnemonic
3	28	29	2	Word number
4	31	34	4	Command data value

Detailed Field Descriptions:

1. The command parameter identifier is specified with a five character decimal integer uniquely identifying the spacecraft or instrument command parameter. This value must be specified in the Command Parameter Specification PDB.

2. The command mnemonic is specified with 20 ASCII characters representing the name of the command parameter. The format for this name is defined in Section 5.2.1. This value must also be specified in the Command Parameter Specification PDB in combination with the command parameter id.

3. The word number is specified as a two character decimal integer (1-33) and indicates the order of data words associated with a command.

4. The command data value is specified as a four-character hexadecimal value indicating the fixed bit pattern of the data word.

5.2.4 Command Variable Data Word Specification Record

The Command Variable Data Word Specification Record defines the subfields associated with variable type commands. Each subfield defines a parameter associated with a command that is to be specified at execution time. Each command of variable type may reference up to 10 subfield names. Optional conversion equation and up to 10 state names may be associated with each subfield. A third order polynomial may be used to reverse calibrate an input subfield value from an EU to a DN using the equation as follows: DN = C0 + C1*EU + C2*EU**2 = C3*EU**3.

PDB Source: FOT

Record Length: 108-453

Record Format:

Field	Start Byte	End Byte	Total Bytes	Contents
1	1	5	5	Command parameter identifier
2	7	26	20	Command mnemonic
3	28	47	20	Subfield name
4	48	60	13	Default value
5	62	65	4	Subfield length
6	67	70	4	Destination first bit
7	72	75	4	Destination last bit
8	77	89	13	Minimum subfield value
9	91	103	13	Maximum subfield value
10	105	107	3	Units
11	109	112	4	Conversion group number 1
12	114	126	13	Start EU number 1
13	128	131	4	Conversion group number 2
14	133	145	13	Start EU number 2
15	147	162	16	State 1
16	164	175	13	State 1 value
.				.
.				.
33	423	438	16	State 10
34	440	452	13	State 10 value

Detailed Field Descriptions:

1. The command parameter identifier is specified with a five character decimal integer uniquely identifying the spacecraft or instrument command parameter. This value must be specified in the Command Parameter PDB.

2. The command mnemonic is specified with 20 ASCII characters representing the name of the command parameter. The format for this name is defined in Section 5.2.1. This value must also be specified in the Command Parameter Specification PDB in combination with the command parameter id.

3. The subfield name is specified with 20 ASCII characters and identifies the name of a subfield associated with a variable type command.

4. The default value is specified with a 13 character floating point value indicating the value to be used if no value is specified when the command is issued. This value is represented as a data number (DN).

5. The subfield length is specified as a two character decimal integer (1-32) indicating the number of bits constituting the subfield value within the command bit pattern.

6. The destination first bit is specified as a four character decimal integer (1-528) indicating the first bit of the command bit pattern where the subfield value will be inserted in the command data message.

7. The destination last bit is specified as a four character decimal integer (1-528) indicating the last bit of the command bit pattern where the subfield value will be inserted in the command data message.

8. The minimum value is specified with a 13 character floating point value representing the lower bound for the associated state of the subfield value range.

9. The maximum value is specified with a 13 character floating point value representing the upper bound of the subfield value range.

10. The units is specified with three ASCII characters representing an abbreviation for the engineering units to which a command subfield value is converted from.

11. The conversion group number 1 is specified with a four character decimal integer and uniquely identifies a set of coefficients associated with an unsegmented 3rd order polynomial equation to be used when the subfield value is greater than or equal to the start EU number 1 (field 12) and less then the start EU number 2 (field 14). This value must be defined in the Polynomial Coefficients Specification PDB. The equation used to reverse calibrate is as follows: DN = C0 + C1*EU + C2*EU**2 + C3*EU**3.

12. The start EU number 1 is specified with a 13 character floating point value representing the lower bound of values for conversion group number 1 (field 11).

13. The conversion group number 2 is specified with a four character decimal integer and uniquely identifies a set of coefficients associated with a conversion equation to be used when the subfield value is greater than or equal to start EU number 2 (field 14). This value must be defined in the Polynomial Coefficients Specification PDB. The equation is specified in field 11.

14. The start EU number 2 is specified with a 13 character floating point value representing the lower bound of values for conversion group number 2 (field 13).

15. The state name 1 is specified with 16 ASCII characters representing a state associated with the subfield.

16. The state value 1 is specified with a 13 character floating point value representing the value to be inserted into the command bit pattern when the user enters state name 1 (field 15).

    .

    .

33. The state name 10 is specified with 16 ASCII characters representing a state associated with the subfield.

34. The state value 10 is specified with 13 character floating point value representing the command bit pattern to be inserted when the user enters state name 10 (field 33).

5.2.5 Command Execution Verification (CEV) Record

The Command Execution Verification (CEV) Specification Record defines a telemetry parameter used to verify the reception and execution of an associated command by the spacecraft subsystem or instrument. Each command parameter may specify one analog or discrete telemetry parameter to verify execution. An range of values in which the telemetry parameter must occur is specified to verify command execution. To indicate an exact value for the telemetry parameter, the low value and high value must be equal.

PDB Source: I&T

Record Length: 130

Record Format:

Field	Start Byte	End Byte	Total Bytes	Contents
1	1	5	5	Command parameter identifier
2	7	26	20	Command mnemonic
3	28	47	20	CEV mnemonic
4	49	50	2	DN/EU indicator
5	52	66	15	CEV low value
6	68	82	15	CEV high value
7	84	95	12	CEV time out
8	97	112	16	CEV mask
9	114	129	16	CEV state

Detailed Field Descriptions:

1. The command parameter identifier is specified with a five character decimal integer uniquely identifying the spacecraft or instrument command parameter. This value must be specified in the Command Parameter Specification PDB.

2. The command mnemonic is specified with 20 ASCII characters representing the name of the command parameter. The format for this name is defined in Section 5.2.1. This value must also be specified in the Command Parameter Specification PDB in combination with the command parameter id.

3. The CEV mnemonic is specified with 20 ASCII characters representing the telemetry parameter whose value verifies the receipt and execution of the command. The format for this name is specified in Section 5.1.2. This name must be specified in the Telemetry Description PDB.

4. The DN/EU indicator is specified with two ASCII characters indicating the units the CEV mnemonic is defined as, i.e. raw data number or engineering units, where:

   DN = raw data number

   EU = engineering units

   This field is only used for analog telemetry parameters, therefore the telemetry parameter must be of type analog. Additionally, a CEV mnemonic expressed in engineering units must also have an associated definition in the Polynomial Coefficients Specification PDB.

5. The CEV low value is specified with 15-characters defining the lowest acceptable value, inclusive, of the CEV mnemonic to verify the command has been properly executed onboard the spacecraft. This value cannot be greater than the CEV high value (field 6). The format for this field is determined by the DN/EU indicator (field 4). A DN/EU indicator set to DN indicates this value will be defined as a raw data number and contains a decimal integer. A DN/EU indicator set to EU indicates this value will be defined in engineering units and contains a floating-point number.

6. The CEV high value is specified with 15-characters defining the highest acceptable value, inclusive, of the CEV mnemonic to verify the command has been properly executed onboard the spacecraft. This value cannot be less than the CEV low value (field 5). The format for this field is determined by the DN/EU indicator (field 4). A DN/EU indicator set to DN indicates this value will be defined as a raw data number and contains a decimal integer. A DN/EU indicator set to EU indicates this value will be defined in engineering units and contains a floating-point number.

7. The CEV time out is specified as a 12 character floating point value indicating the maximum time in seconds for verification of the transmitted command to occur before it is considered to have failed.

8. The CEV mask is specified with 16 ASCII characters representing the bit pattern in hexadecimal format that is logically combined with the expected value and the value of the telemetry point used to verify the command. The mask concept provides the capability to have a multi-bit telemetry point serve as the CEV mnemonic for a command that will only cause 1 bit of the multi-bit point to change.

9. The CEV state is specified with 16 ASCII characters and provides the text associated with the CEV mnemonic used to verify command execution. This value will override the use of the expected value (fields 5 & 6) when both are specified.

5.2.6 Command Long Description Record

The Command Long Description Record provides a detailed description for a command parameter.

PDB Source: I&T

Record Length: 1628

Record Format:

Field	Start Byte	End Byte	Total Bytes	Contents
1	1	5	5	Command parameter identifier
2	7	26	20	Command mnemonic
3	28	1627	1600	Command long description

Detailed Field Descriptions:

1. The command parameter identifier is specified as a five character decimal integer and uniquely represents the command parameter. This value must also be defined in the Command Description PDB.

2. The command mnemonic is specified with 20 ASCII characters representing the name of the command parameter. The format for this name is specified in Section 5.2.1. This name must also be defined in the Command Description PDB in combination with its command parameter id.

3 The command long description is specified with 1600 ASCII characters providing a detailed description of the command parameter.

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Abbreviations and Acronyms

APID	Application Identifier
ASCII	American Standard Code for Information Interchange
ASTER	Advanced Spaceborne Thermal Emission and Reflection Radiometer
BDU	Bus Data Unit
C&DHS	Command & Data Handling System
CCB	Configuration Control Board
CCR	Configuration Change Request
CCSDS	Consultative Committee for Space Data Systems
CDR	Critical Design Review
CDRL	Contract Data Requirement List
CERES	Clouds and the Earth's Radiant Energy System
COMMS	Communications
CTIU	Command/Telemetry Interface Unit
DBA	Data Base Administrator
DCN	Document Change Notice
DFCD	Data Format Control Document
DID	Data Item Description
ECS	EOSDIS Core System
EDOS	EOS Data Operations System
EDU	EDOS Data Unit
EOC	EOS Operations Center
EOS	Earth Observing System
EOSDIS	Earth Observing System Data & Information System
ESDIS	Earth Science Data and Information System
EU	engineering unit
FOS	Flight Operations Segment

FOT	Flight Operations Team
GN&CS	Guidance, Navigation and Control System
GSFC	Goddard Space Flight Center
I&T	integration & test
ICD	Interface Control Document
IRD	Interface Requirement Document
IST	Instrument Support Terminal
NASA	National Aeronautics and Space Administration
ODB	Operational Data Base
PDB	Project Data Base
RT	remote terminal
SCC	Spacecraft Control Computer
SDVF	Software Development and Validation Facility
SOW	Statement of Work
TBC	To Be Confirmed
TBD	To Be Determined
TBR	To Be Resolved
TBS	To Be Supplied